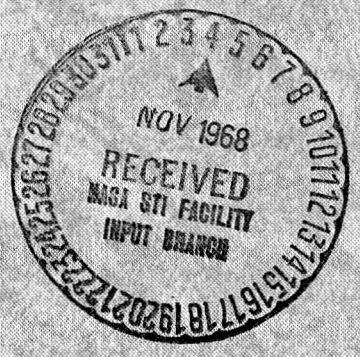

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Pravda, August 31, 1960

S. Vernov and N. Grigorov

Translated by Joseph L Zygielbaum

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IN THE DEPTHS OF THE MICRO-WORLD

by

S. Vernov
Member Correspondent of the Academy of Sciences USSR

and

N. Grigorov
Professor

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Until now all investigations of cosmic space were conducted with the help of automatic devices and instruments. Results of the measurements were transmitted to Earth by radio. Such methods for obtaining scientific results limited considerably the means and objects of investigation that could be accomplished by the use of satellites and rockets. The return of a spaceship-satellite to Earth has introduced tremendous opportunities for scientists to obtain vast amounts of scientific information which has not been available by means of radio transmission.

Physicists have at their disposal a very precise method for investigation which enables them literally to separate processes that take place in the micro-world. This is the method of nuclear, thick-layer photo emulsion which was proposed and developed by the Soviet physicists, L. V. Mysovsky and A. P. Zhdanov. The exclusive value of the photo emulsion method for the study of cosmic rays was demonstrated during the outstanding investigations which were conducted by the foreign member of the Soviet Academy of Sciences, the known English physicist, S. F. Powell.

This method is based on the fact that any rapidly moving charged particle moving through a specially prepared photo emulsion leaves a trail in the form of separate grains, which look like dark spots on a light background after the development of the photo film. The greater the electrical charge of the particle, or the slower the particle moves, the closer these grains will be located from each other and the trace will become more dense and darker.

As a result of this particular property of nuclear photo emulsion, it is possible to determine the basic properties and the character of movements of the microparticles that leave trails in the emulsion: charge, mass, velocity, and path determination.

Photo film has proven to be a priceless asset to the physicist. With the help of these films, it was established that among the original cosmic rays which come to us from the depths of the universe are our present atomic nuclei of various elements, ranging from the nuclei of the hydrogen (protons) to the nuclei of iron. Also facilitated by films, physicists have been able to see what takes place when an original high energy cosmic particle collides with an atomic nuclei. During such a collision the nuclei is destroyed and the separate particles that make up the nuclei fly away in many directions creating new elementary particles, the nature and properties of which are disclosed by the same nuclear photo emulsion.

With the help of photo emulsion it is possible to obtain sufficiently detailed pictures of these phenomena. When examining photo emulsion through a microscope it is possible to reconstruct a complete picture of the processes of creation and perish of new particles, which take place during a billionth of a second or less.

In order to utilize the great possibilities of photo emulsion methods for the study of cosmic radiation, it is necessary to know how to retrieve the emulsion from space. This possibility was realized during the flight of the second Soviet spaceship-satellite. The Earth-Cosmos-Earth flight has made it possible to approach in a new manner the study of cosmic rays beyond the limits of the atmosphere by the use of nuclear photo emulsion.

In spite of the fact that cosmic rays have been intensively and successfully studied for the last few decades, these emissaries from the depths of the universe still interest many investigators. The reason for the great interest which scientists devote to cosmic rays is easily understandable. Cosmic rays are component particles which are charged with such high energy that they cannot be duplicated under laboratory conditions in an artificial way. Original cosmic rays possess particles with energies of millions and millions times larger magnitude than the maximum energy of particles which are created in one of the most powerful accelerators of the world--the Dubna synchrophazotron. In order to study the elementary particles of matter and in order to clarify any internal structure details of these particles, it is necessary to have a probe capable of penetrating deep into the interior of these particles. A high energy particle, primarily an original high energy cosmic particle, is such a probe. It is believed by astrophysicists that cosmic rays are witnesses of the unknown processes that take place in the realms of the universe which are responsible for the creation of cosmic rays. The investigation of the contents of original cosmic radiation with the help of the electronic instruments installed aboard the spaceship-satellite, as well as with the help of photo emulsion, makes it possible

study more thoroughly these processes. It is possible that the discovery of the secrets of the origin of cosmic rays will make it possible for physicists in the future to create these processes under Earthly conditions and to obtain eventually new means for acceleration of particles to colossal energies.

During their journey to Earth cosmic rays pass through interplanetary space. This causes a unique elimination of space. The properties of cosmic space determine the character of these radiations which pass through it. Therefore, by studying cosmic rays, we are in a position to determine what takes place at very large distances from our planet.

Why is it necessary to study cosmic rays at the highest possible altitudes beyond the realms of the Earth's atmosphere? It was established comparatively long ago, with the help of automatic instruments which were sent aboard sounding balloons to altitudes of 20 to 30 km, that the original cosmic rays interact strongly with atomic nuclei and quickly use up the energy during the creation of new particles. These particles are absorbed in the atmosphere and almost never reach the sea level. The cosmic radiation which does reach the surface of the Earth originates entirely differently. This radiation is essentially different from the original cosmic ray. Therefore, in order to utilize the original cosmic radiation as a means for the investigation of the micro-world and the entire universe, it is necessary to work with the original particles in their original form before they have a chance to interact with the atomic nuclei of the atmosphere and before they change their nature and lose their energy. In other words, these particles should be utilized beyond the realm of our atmosphere.

As was already stated, the second spaceship-satellite carried instruments with nuclear photo emulsion. These instruments were designed for study of the original

cosmic radiation contents, and the presence of nuclei of various elements in it. Other instruments were carried for study of the interaction of original cosmic particles with atomic nuclei. Photo emulsion was exposed to original cosmic rays and has been returned to the laboratory where it is being studied at the present time.

In addition to photo emulsion, the spaceship also carried various instruments which permitted study of other radiations in cosmic space. One group of instruments has measured ultraviolet and soft X-radiations; these types of radiation are closely related to solar activities. In spite of the fact that these radiations are absorbed in the uppermost layers of our atmosphere, they have an essential effect on processes which take place in the Earth's atmosphere.

Present aboard the spaceship were the dogs Belka and Strelka, rats, mice, micro-organisms, plants, etc. In order to know the dosage of radiation which these life forms have received, special dosage meters were installed aboard the spaceship-satellite. With the help of these instruments, it was possible to determine the intensity of the particles with low energies as well as those with high energies. A combination of these data makes it possible to determine which radiation exists at an altitude of about 300 km above the Earth's surface, how it penetrates inside the spaceship, and how it affects the biological objects in nuclear photo emulsion.

The great size of the Soviet spaceship-satellite has permitted such a great amount of material to be lifted beyond the atmosphere that it will be possible to completely follow in the photo emulsion the entire combination of phenomena which appear under the effect of particles with high and superhigh energies. New opportunities have been opened for the application of methods for measuring original cosmic particle energies regardless of their magnitude. This means that it will be possible to

conduct detailed investigations of the physical processes of collisions between particles with superhigh energies and atomic nuclei. The experiments with nuclear photo emulsion which were conducted aboard the second spaceship-satellite placed the cornerstone for this new type of investigation of cosmic rays.

Each new scientific conquest represents not only an area which was taken from nature after a great struggle but also an area of concentration on which new studies of the unknown will be originated.